MR imaging offers theoretically the optimal imaging approach in patients with right ventricular dysfunction. In view of its superb spatial resolution and unlimited field of view, MR imaging offers an excellent opportunity to visualize the right ventricle not only in an anatomical and morphological, but also in a functional and flow-dynamic sense. Compared to most other imaging modalities, MR imaging allows a truly three-dimensional calculation of ventricular volumes and is therefore more accurate in the analysis of right ventricular function. In addition, MR imaging offers unique features such as velocity mapping of tricuspid flow, myocardial muscle strain measurements using MR tagging of the right ventricle, and the assessment of right ventricular diastolic function. In particular, in patients with ARVD/C global and regional abnormalities can be observed. These patients may not have abnormalities visualized by other imaging techniques. These abnormalities include right ventricular aneurysms, regional thinning, failure of systolic thickening, ventricular dilatation, and impaired global and diastolic function. Furthermore, MR imaging has the specific advantage of clearly characterizing adipose infiltration by showing myocardial areas with high-signal intensity. Based on these characteristics, MR imaging is potentially the most accurate imaging modality in patients with right ventricular dysfunction due to ARVD/C [1–9].

In the past, several studies have addressed the value of MR imaging in the detection of ARVD/C [10–24]. Auffermann et al. [12] showed in 36 consecutive patients with biopsy-proved ARVD/C that right ventricular ejection fraction was significantly lower in patients with inducible ventricular tachycardia during invasive electrophysiologic studies compared to those patients without inducible ventricular tachycardia. In addition, the patients with inducible ventricular tachycardia showed increased fatty replacement and impaired diastolic right ventricular function. It was concluded that MR imaging is a useful clinical tool for detecting ARVD/C and a worthy substitute for angiography and biopsy in the follow-up of patients with ARVD/C.

Midiri et al. [20, 21] studied patients with a suspected diagnosis of ARVD/C and the authors employed the following 5 anatomical, morphological and functional MR criteria for the diagnosis: (1) presence of high-signal intensity areas indicating the substitution of myocardium by fat, (2) ectasia of right ventricular outflow tract, (3) dyskinetic bulges, (4) dilatation of the right ventricle, and (5) enlargement of the right atrium. Fat substitution was seen in 46.6% of patients, dyskinesia in 13.3%, ectasia of the right ventricular outflow tract in 26.6%, right ventricular dilatation in 26.6%, and right atrial enlargement in 26.6%.

The study by Keller et al. from the group of Buser [22], published in this issue of the International Journal of Cardiovascular Imaging, evaluated the diagnostic and prognostic value of MR imaging in 36 patients with suspected ARVD/C. The diagnosis of ARVD/C was clinically diagnosed in 19 patients and excluded in 17 patients. MR imaging showed a positive predictive value of 84% and a negative predictive value of 88% for diagnosing ARVD/C. The authors used multiple MR imaging parameters and they demonstrated that fatty infiltration of right ventricular tissue was highly predictive of the diagnosis. In fact, fatty tissue infiltration was the only significant parameter for confirmation of the diagnosis. More importantly, six patients (37%) with MR signs of ARVD/C showed an arrhythmic event versus only one patient (6%) without MR signs for the disease. The important message was that MR imaging may contribute to institution of appropriate therapy in...
patients with ARVD/C, such as adequate drug therapy (sotalol) or implantation of an internal cardioverter defibrillator (ICD). One could of course always question the appropriate selection criteria in defining patients with suspected ARVD/C as the authors used a clinical diagnosis as the gold standard (as also been mentioned by the authors). An alternative might be to select patients with documented right ventricular outflow tract tachycardias. These patients are usually better defined, and in general practice patients with ARVD/C may present with nonsustained right ventricular tachycardias as a first sign. In addition, MR imaging may play a vital role in these patients.

Several previous studies have examined the value of MR imaging in patients who showed right ventricular outflow tract tachycardias as a first manifestation [25–37]. Carlson et al. [25] showed in 22 patients with right ventricular tachycardia with a normal left ventricular function and no evidence of coronary artery disease, that cine MR imaging revealed right ventricular abnormalities in 95% of patients. It was clearly demonstrated that the right ventricular outflow tract ventricular tachycardia was associated with local structural and wall motion abnormalities of the right ventricular outflow tract. The abnormalities of the right ventricle included fixed focal wall thinning, regionally decreased wall thickening and abnormal wall motion during systole. The most common finding was regionally decreased systolic wall thickening and abnormal wall motion. Interestingly, the structural abnormalities observed by MR imaging were often not detected by echocardiography. Globits et al. [26] examined 20 patients who underwent radiofrequency catheter ablation for symptomatic right ventricular outflow tract tachycardia. In 13 (65%) of 20 patients, MR imaging revealed various structural abnormalities, including focal wall thinning, right ventricular outflow tract dilatation, saccular aneurysms in the right ventricular outflow tract, and fatty infiltration of the right ventricular outflow tract. MR imaging abnormalities within the right ventricular outflow tract were significantly associated with the origin of tachycardia. Proclemer et al. [29], using spin-echo MR imaging, investigated 19 patients who had frequent ventricular extrasystoles (>100/h) with left bundle branch block pattern. All patients had a normal two-dimensional echocardiogram. MR imaging showed that the dimensions of the right ventricular outflow tract were significantly wider than in a control group consisting of 10 volunteers. The similarity of these findings with those previously obtained in patients with right ventricular tachycardia suggest a common substrate of the right ventricular outflow tract arrhythmias. In our institution, Kayser et al. [33] showed that the diastolic function of the right ventricle was significantly altered in 15 patients with nonischemic tachyarrhythmias of right ventricular origin, but systolic function was preserved. Of the 15 patients, 5 (33%) patients showed clear evidence of ARVD/C, indicating that ARVD/C may be associated with diastolic function abnormalities preceding systolic function abnormalities. Recently, Kayser et al. [35] showed in 25 patients with ventricular tachycardia and a left bundle branch pattern that the 14 patients with MR features of ARVD/C showed reduced right ventricular diastolic dysfunction. It was concluded that MR imaging provides important information beyond electrocardiographic criteria. In the study by Keller et al. [22], nonsustained ventricular tachycardias were found in 53% of patients on Holter-monitoring, and inducible sustained ventricular tachycardias had been observed in 36% of patients. It might have been interesting to see whether the patients with documented ventricular tachycardias were different from those patients who only showed palpitations, syncope, or survivors of sudden death in terms of MR imaging features.

To summarize, MR imaging can be validly used to show characteristics of the right ventricle that strongly support the clinical diagnosis of ARVD/C. MR imaging provides the most important anatomical, morphological, functional and flow-dynamic criteria for diagnosis of ARVD/C within one single study. The noninvasive nature of MR imaging makes it an excellent screening tool for the detection of ARVD in family members who may be at risk of sudden death, and for following the progress of the disease. Lastly, MR imaging may provide a useful guide to the electrophysiol-